PH-Responsive saloplastics based on weak polyelectrolytes: From molecular processes to material scale properties

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ABSTRACT

Compact polyelectrolyte complexes (COPECs), also named saloplastics, represent a new class of material with high fracture strain and self-healing properties. Here, COPECs based on poly(methacrylic acid) (PMAA) and poly(allylamine hydrochloride) (PAH) were prepared by centrifugation at pH 7. The influence of postassembly pH changes was monitored chemically by ATR-FTIR, ICP, DSC, and TGA, morphologically by SEM, and mechanically by strain to break measurements. Postassembly pH stimuli misbalanced the charge ratio in COPECs, impacting their concentration in counterions, cross-link density, and polymer chain mobility. At the material level, changes were observed in the porosity, composition, water content, and mechanical properties of COPECs. The cross-link density was a prominent factor governing the saloplastic's composition and water content. However, the porosity and mechanical properties were driven by several factors including salt-induced plasticization and conformational changes of polyelectrolytes. This work illustrates how multiple-scale consequences arise from a single change in the environment of COPECs, providing insights for future design of stimuli-responsive materials.

KEYWORDS:

Mechanical properties; Polyelectrolytes; Porosity